CENTRAL CALIFORNIA AIR QUALITY RESEARCH

How Science is Charting a Path to Cleaner Air.

Wednesday, May 17, 2006

Piccadilly Inn, University
4961 N. Cedar Avenue
Fresno, California

How Science is Charting a Path to Cleaner Air.

Particulate Matter -
What does the study tell us about the San Joaquin Valley particulate matter problem?

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May 17, 2006

Research to Guide and Inform

- What did we know prior to the study?
- How was the CRPAQS study designed to improve our understanding?
- What does the study tell us about San Joaquin Valley particulate matter?
- What results are the most useful for the future for the SJV and other areas?

CRPAQS California Regional PM10/PM2.5 Air Quality Study

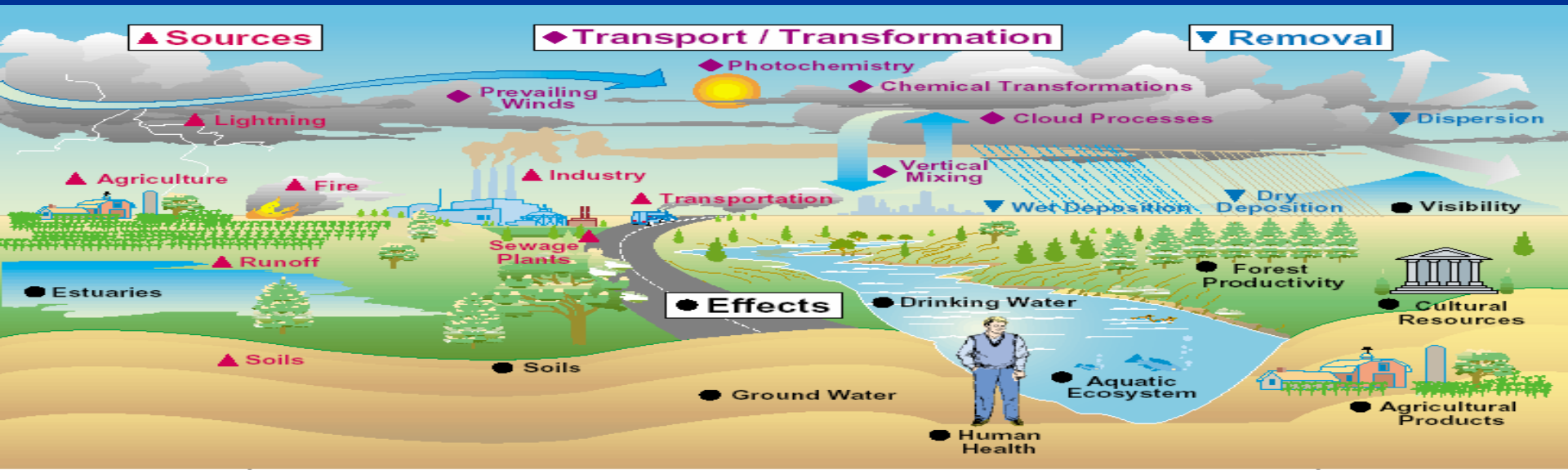
What did we know prior to the study?

- **Fall:** Detected soil related material in the air
  - *Amount from rural and urban sources uncertain*
- **Winter:** More carbon and nitrates in the air
  - *Key sources not identified*
- **Annual:** Soil dominated, length of events unknown
  - *Estimated contributions from roads and agricultural activities*
  - *More measurements needed*

Fugitive Dust | Carbon | Ammonium Sulfate | Ammonium Nitrate | Other

What did we know prior to the study?

- **Atmospheric reactions:** Particulate forming from gases – *Unknown reaction rates & limits*
- **Duration of events:** Filter samples once every six days left gaps – *Needed time of day & daily measurements to identify key sources*
- **Fog:** Winter particulate effect unclear – *Chemistry measurements within fog needed*



How was the study designed to improve our understanding?

- Urban, rural and regional study of particles, gases and visibility
- Comparisons of measurement devices
- Particle characteristics studies
- Direct emission measurements
- Agricultural air quality research with USDA
- Atmospheric process computer simulations

California Regional PM10/PM2.5 Air Quality Study

California Regional PM10/PM2.5 Air Quality Study Components

- **Planning** 1993 - 1999 Initial research, technical support studies, 1995 SJV mini-study (IMS95)
- **Emissions Inventory Improvements** 1999 - 2002
- **Main Field Study** December 1999 - January 2001
- **Analysis of Field Study Data** 2002 - 05
- **Computer Simulations** 2000 - 07 testing new air quality models with field study data

CRPAQS -Fully funded budget $28.5 million.

Technical Support Studies

- Assessing summer 1990 database for modeling
- Equilibrium model predictive evaluations
- Determining measurements needed for modeling
- Characterizing meteorological spatial scales
- Assessing needs for a fall episodic field study
- Expanding region included in winter study
- Sampling representativeness & uncertainties
- Comparing soundings by different radar devices
- Determining PM10 sample collection times
- Comparison of monitoring equipment

Technical Support Studies

- Dynamics of fog formation and dissipation
- Assessing the magnitude of NOx emissions from soils in the San Joaquin Valley
- Evaluation of methods for determining ammonia emissions in the San Joaquin Valley
- Evaluating use of tracer materials to identify geologic sources
- Evaluating use of tracer materials to track the fate of primary and secondary combustion aerosols

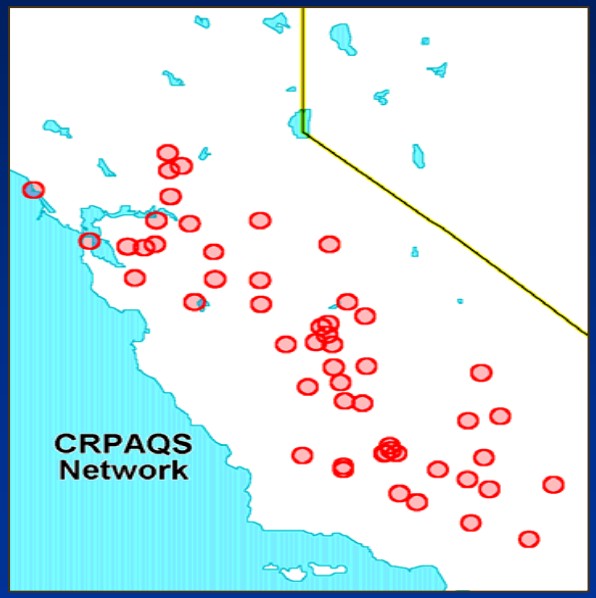
CRPAQS Preliminary Field Study 1995 Integrated Monitoring Study

IMS95 preliminary fall, winter & fog field measurement program objectives:

- Scientific design tool for main study
- Evaluate fall and winter PM10 and PM2.5
- Provide interim products to support SIP
- Provide initial database to evaluate air quality models

CRPAQS Main Field Study 1999 - 2001

- Main field study with added sites to collect regional data for analysis and modeling
- Measurements to understand particle size, hourly and multi-day variations
- Tower measurement of particles and gases
- Fog chemistry measurements



CRPAQS Science Projects

Meteorological methods evaluation
Dispersion under low wind speeds

Spatial representativeness of monitor
Zone of influence of source
Meteorological measurements network

Emissions reconciliation
Emissions source activity detection

Background concentrations
Gas/aerosol organic carbon composition
Gas/aerosol phase distribution
Ammonium nitrate & NOx, SO2 and NH3

CRPAQS Science Projects

Regional versus local nature of aerosols
Secondary organic formation in winter

Fog effect on PM amount & composition
Acid fog aerosol formation
Aerosol formation atmospheric dynamics
Deposition and fogs
Characterization of 3-D fog fields

Visibility spatial and temporal patterns
Visibility reduction chemical constituents
Light scattering measurement analysis
Particle chemistry for light extinction
Emissions sources for light extinction

CRPAQS Science Projects

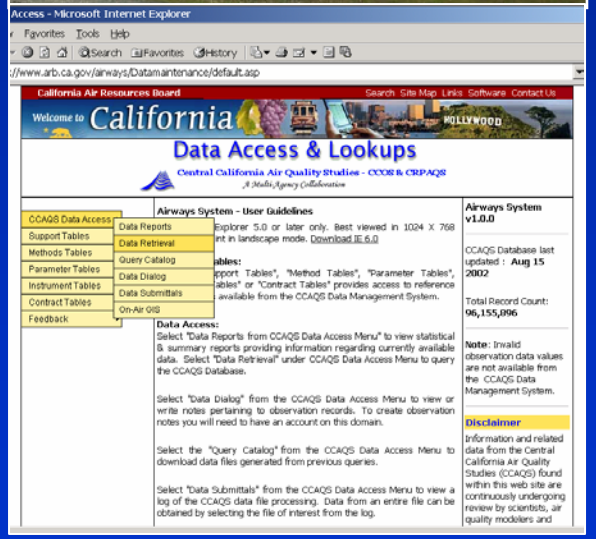
- Continuous hourly PM_{10} and $PM_{2.5}$ mass, particulate carbon
- Fog sampling (ground and Angiola tower)
- Particulate light scattering (nephelometer)
- Particulate light absorption (aethalometer)
- Hydrocarbons (canisters)


Fresno 1st Street

CRPAQS Science Measurements

- Gas samplers (O_3 No_y PAN/NO_2 ammonia, nitric acid)
- Continuous nitrate and sulfate
- Sequential filter sampler mass, elements, carbon, ions
- Particle size, carbon and ions (MOUDI)
- Single particles (ATOFMS)
- Semi-volatile organics (PUF/XAD)
- Light hydrocarbons (Canisters)
- Heavy hydrocarbons (Tenax)
- Carbonyls (DNPH cartridges)

Review of Collected Data



- **Monitoring Data Submitted**
  - Surface & aloft meteorology
  - Ozone, precursors, gases
  - PM mass & chemical species
  - Annual, Fall & Winter
  - Visibility
- **Combined Data System**
  - System developed
  - Data submitted
  - Quality reviewed
  - Public access

Processing to Provide Results

- Quality assurance and data analysis contracts
- Technical Committee review
- Additional quality assurance efforts
- Multiple evaluations and use by various agencies and organizations
- Detailed evaluation in SJV SIP processes
- ARB and UC Davis computer modeling

What does the study tell us about San Joaquin Valley particulate matter?

- **How to select appropriate monitoring sites, what types of monitoring equipment are needed and how frequently to measure**
- **More accurate emissions rates for field agricultural activities and many other types of sources**
- **How environmental variations affect particulate formation -** This helps with forecasting, allowing us to alert the community to take extra actions to reduce emissions

What does the study tell us?

- **How urban emissions interact with rural emissions** particulates formed by interaction of nitrogen oxide and ammonia
- **How pollutants form at various times and places** This conceptual model identifies important sources to improve prediction of the effect of changes in regional emissions
- **Wood smoke control is effective in the SJV** Residential wood combustion contributes significantly to peak urban winter PM10 concentrations

What does the study tell us?

- **FOG** Dense fog can increase the production of some pollutants but reduces others and removes some particles from the air by attaching to the particles and depositing them on the ground
- **NOx** The amount of NOx limits the amount of ammonium nitrate particulate that will be formed because there is much less NOx than ammonia; therefore, NOx reductions are most effective in reducing SJV winter nitrate particulates.
- **CARBON** Most particulate carbon is directly emitted, coming from residential wood combustion, mobile sources and cooking. 10 to 20% of organic carbon may be due to secondary formation from gaseous precursors.

What results are most useful for the future for the SJV and other areas?

- Data and modeling for SIP design and evaluation
- Regional improvement in the ability to predict high levels and warn the public
- Confirmation of the effectiveness of the controls that have been implemented

CRPAQS Products for PM_{10} SIP

- **Emissions Inventory Projects**
  - New transportation network & activity mapping
  - Complete spatial data & micro-inventory
  - Improved ammonia inventory
  - Reanalyzed selected speciation profiles
- **Data Analysis**
  - Characterization of episodes
  - Representativeness of episodes
- **Air Quality Modeling**
  - Receptor modeling, various methods tested
  - Grid-based computer simulation of IMS95 and main field study, also will be used for PM2.5 SIPs

CRPAQS Products for $PM_{2.5}$ SIP

- **Data Analysis**
  - Characterization of episodes from study data includes PM2.5 and precursors
  - Episode evaluations complete
- **Air Quality Modeling**
  - New modeling methods developed
  - Grid-based computer simulation of main field study covering region will be used for PM2.5 SIP
- **Modeling Supports Plan Development**
  - Allows analysis of contributing sources
  - Allows evaluation of changes in emissions